# MODULAR THINKING FOR A SUSTAINABLE FUTURE

THE CLIMACOOL CONTRIBUTION TO DECARBONIZATION AND FLEXIBILITY IN HVAC SYSTEMS









## **YOUR PRESENTER**



# MICHAEL MEDLOCK

Decarbonization Guru



Modular Chiller/Heater Systems



Water-Source Heat Pump Solutions



Hydronic Fan Coil Solutions



Custom Air Handlers



# 

What Are Modular Chillers?

Modular Chiller's Role in Sustainability

**Applications of Modular Chillers** 



# **MODULAR CHILLERS**

#### **Designed to be banked together**

- •Controls supports up to 12 modules
- Single Point power available
- •Skidding available
- Up to 8-inch pipe which allows to about 600 tons per bank

Limitations	
Hot Water production	70° – 140° F
Chilled Water production	15° – 65° F
Ambient Operation	0°–120° F







## MARKET EVOLUTION

- Retrofit cooling
- New construction heating

## BENEFITS

Redundancy

- Mechanically
- ✓ Controls

## Multifunctionality

Single plant solutionsHybrid systems

# **MODULAR CHILLERS**



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## BENEFITS

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- ✓ Mechanically
- ✓ Controls

#### MULTIFUNCTIONALITY

✓ Single plant solutions✓ Hybrid systems



\* Simplified single line water circuit shown; V=motorized isolation and control valve

# **MODULAR CHILLERS**

## **ClimaCool solutions**

All Electric

**High Efficiencies** 

Hydronic distribution systems

- $\checkmark$  Centralized heating and cooling solution
- ✓ High capacity per square foot
- ✓ Low charge per circuit







# 

## What Are Modular Chillers

## Modular Chiller's Role in Sustainability

- Decarbonization / Electrification
- A2L Refrigerants
- Geothermal

## **Applications of Modular Chillers**

## DECARBONIZATIONS

Decarbonization' tends to refer to the process of reducing 'carbon intensity', lowering the amount of greenhouse gas emissions produced by the burning of fossil fuels. Generally, this involves decreasing CO2 output per unit of electricity generated.

#### **Increasing Electrification**

• From boilers to compression systems

#### **Improving efficiencies**

· From air source to water source





## DECARBONIZATION

#### CLIMATE CHANGE

#### FOSSIL FUEL CONSUMPTION

#### POLITICAL WILL

- Local gas bans and electrification codes
- Bans on Bans

#### SOCIETAL WILL

 1/3 of fortune 500 companies have formal sustainability goals



THE CLIMATE TARGETS

**RENEWABLE 100% (RE100)** 

Achieved when a company relies

n 100% renewable energy

SCIENCE BASED TARGETS (SBT

Emissions are reduced in line with

the need to keep global warming below 2 degrees Celsius.

**OF FORTUNE 500 COMPANIES** 

Achieved when a company complete

offsets its greenhouse gas emissior

CLIMATE TARGET TYPE

Fortune Global 500 companies with formal climate targets<sup>2</sup>: **163** 

Countries represented

States advancing or prohibiting building gas bans and electrification codes





Decarbonize - reduce carbon emissions (CO<sub>2</sub>)

Greenhouse gases (GHGs)

- Carbon Dioxide (CO<sub>2</sub>) & Fluorinated Gases
- Methane, Nitrous Oxide

Commercial, residential, and industrial buildings represent 40+% of the world's energy consumption & GHG emissions

We are shifting HVAC from CO2 to fluorinated gases so its important to also look at the impact of fluorinated gases



#### Overview of U.S. Greenhouse Gas Emissions in 2019





#### How are they similar?

- A1 & A2L are nontoxic.
  - A1 410A R-32 / R125
  - A2L 454B R-32 / R1234yf
  - A2L R-32

#### How are they different?

A1

✓ does not show flame at test condition

#### A2L

- ✓ Ignitable
- ✓ Low flame speed and low heat of combustion
- ✓ Lower GWP

#### ASHRAE 34 and ISO 817 Refrigerant Classification

(S <sub>u</sub> & HOC)	Higher Flammability	A3	B3
lammability	Lower Flammability	A2	B2
Ising F	1	A2L	B2L
Increa	No Flame Propagation	A1	B1
		Lower Toxicity	Higher Toxicity
	Increasing Toxicity		

Class 3 Requirements 1. Exhibit flame propagation @ 60°C & 101.3 kPa 2. LFL ≤ 0.10 kg/m³ or HOC ≥ 19,000 kJ/kg	R-290 Propane
Class 2 Requirements 1. Exhibit flame propagation @ 60°C & 101.3 kPa 2. LFL > 0.10 kg/m <sup>3</sup> 3. HOC < 19,000 kJ/kg	R-152a (hairspray, dust-off)
<u>Class 2L Requirements</u> 1. Same as Class 2 requirements & S <sub>u</sub> ≤ 10 cm/s	R-32, R-454A etc.
<u>Class 1 Requirements</u> 1. No flame propagation @ 60°C & 101.3 kPa	R-410A

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## **Applications of Modular Chillers**

- Cooling
- Heating
- Heat Recovery
- Single plant solution
- Condenser Loop Conditioning

## SYSTEM EXAMPLE



## COOLING



## WATER SOURCE EQUIPMENT

✓ Replacement equipment

- ClimaCool supports constant volume replacements
- ✓ Critical loads (redundancy)



Boiler



## HEATING

## WATER SOURCE EQUIPMENT

• Replace Boiler with Air Source heat pump



## **DESIGN CONSIDERATIONS**

- Outdoor ambient
  - Compressor technology
  - Capacity Derates
- Defrost derates





## MULTIFUNCTIONALITY

#### **HEATING FOCUSED**

- Replace Boiler with Air Source heat pump
- Downsize chiller by heat pump capacity
- Use heat pump as swing or chiller / heat recovery chiller



#### **COOLING FOCUSED**

- Replaced chiller/ tower with ASHP
- Get as much heating as possible – switch over to boiler solution
  - Should cover 95% of the design days
  - Keeps cost and footprint minimal



## SINGLE PLANT SOLUTION

## ClimaCool

- ✓ Single equipment integration for heating and cooling
- ✓ All electric solution
- ✓ High Efficiencies
- ✓ Dual Redundancy

### **AIR SOURCE**

✓ 300 tons

## WATER SOURCE

 ✓ 2500 tons (driven by the heating load)











**Building Load** 



## **CONDENSER LOOP CONDITIONING**

## n n 20-(f) (f) (a)-WATER SOURCE HEAT PUMPS WITH BOILER / TOWER 006 thru 015 006 thru 015 006 thru 015 **Cooling Tower** 009 thru 036 📛 R 006 thru 120 006 thru 300 Boiler

**Building Load** 



## **CONDENSER LOOP CONDITIONING**

### **ClimaCool Solution**

## Replace boiler with ASHP

✓ Decarbonization

#### Replace Tower with ASHP

- ✓ Water conservation
- ✓ Closed loop / lower maintenance





#### ASHP

- $\checkmark$  Operating limits 0 to 120 ambient
- ✓ Controls do not require a BAS
  - ASHP standard mode conditions loop temps
  - WSHP can be controlled by thermostats

**Building Load** 



## **ClimaCool Expertise**

Collaborate with ClimaCool for your next project and explore the details that make projects successful.

System pumping
System Bypass
System Volume
Multiple bank installations
Controls integration
Hybrid systems integration
Project examples

